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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/752,642

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EXAMINER

CHU, CHRIS C

ART UNIT

PAPER NUMBER

2815

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/752,642	<b>Applicant(s)</b> NAKAMURA ET AL.	
	<b>Examiner</b> CHRIS C. CHU	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 04 May 2009.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1 - 14 is/are pending in the application.
- 4a) Of the above claim(s) 5 - 10, 13 and 14 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 - 3, 11 and 12 is/are rejected.
- 7) ☒ Claim(s) 4 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment filed on May 4, 2009 has been received and entered in the case.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 2, 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pramanick et al. (U. S. Pat. No. 6,147,404) in view of Halliyal et al. (U. S. Pat. No. 6,731,006).

Regarding claim 1, Pramanick et al. discloses in e.g., Fig. 4 a semiconductor device (200; column 2, line 47) having a multilayer structure (see e.g., Fig. 4), comprising:

- at least two wiring layers (101 and 204; column 4, lines 33 and 34), each formed in a wiring groove formed in a corresponding insulating film (105 and 108; column 3, lines 42 – 44 and column 4, line 39); and
- a via contact (the via contact 202; column 5, line 4) embedded, in a via hole (118; column 4, line 56) formed in an insulating film (116; column 4, lines 4 and 5) formed between the at least two layers (101 and 204) and made of a metal wiring material which is the same as that of the at least two wiring layers (101 and 204; column 4, lines 13 – 15, column 5, lines 4 – 6 and see e.g., Fig. 4).

Pramanick et al. does not disclose an additive within the metal wiring material of the via

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contact. Halliyal et al. teaches in e.g., Fig. 1H a metal wiring material (the material that is located in the via 116; column 6, lines 60 – 65) of the via contact (116; column 6, line 61) containing an additive (the dopant material; column 7, lines 1 – 6). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the dopant material of Halliyal et al. as the specific material to form the additive within the metal wiring material of the via contact of Pramanick et al. as taught by Halliyal et al. to reduce electromigration of copper or the movement of copper atoms along the channels or vias under the influence of electrical current (column 7, lines 6 – 10). Furthermore, the combined structure of Pramanick et al. and Halliyal et al. disclose the following limitation “the additive which is not contained in the metal wiring materials of the at least two wiring layers.”

Regarding claims 2 and 12, Pramanick et al., as modified, discloses in e.g., Fig. 4 the metal wiring material (101 and 204) being Cu (column 4, lines 13 – 15 of Pramanick et al.) and the additive (the dopant material) being Sn, Rh, Zn, Al, Ru, Cr, Pd, In, Mg, Co, Zr, Ti, Ag, Ir, Ni, Ge, Nb, B, Or Hr (column 7, lines 1 – 6 of Halliyal et al.).

Regarding claim 11, Pramanick et al. discloses in e.g., Fig. 4 a semiconductor device (200) comprising:

- a first metal wiring layer (101) made of a first wiring material (column 4, lines 13 – 15), formed in a first wiring groove formed in a first insulating film (105) on a semiconductor substrate (the semiconductor substrate of the semiconductor device 200; column 2, lines 24 – 28);
- a second insulating film (114) on the first insulating film (105) having the first wiring layer (101) embedded therein (see e.g., Fig. 4);

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- a via contact (the via contact 202) embedded in a via hole (118) formed in the second insulating film (116; see e.g., Fig. 4), the via contact (the via contact 202) being made of the same wiring material as the first wiring material (column 5, lines 4 – 6, column 4, lines 13 – 15 and see e.g., Fig. 4);
- a third insulating film (116) on the second insulating film (114) having the via contact (202) formed therein (see e.g., Fig. 4); and
- a second metal wiring layer (204) embedded in a second wiring groove (the opening within the layer 108) formed in the third insulating film (108; see e.g., Fig. 4), the second metal wiring layer (204) being made of the same metal wiring material as the metal wiring material of the first metal wiring layer (101; column 4, lines 13 – 15 and see e.g., Fig. 4).

Pramanick et al. does not disclose an additive within the metal wiring material of the via contact. Halliyal et al. teaches in e.g., Fig. 1H a metal wiring material (the material that is located in the via 116; column 6, lines 60 – 65) of the via contact (116; column 6, line 61) containing an additive (the dopant material; column 7, lines 1 – 6). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the dopant material of Halliyal et al. as the specific material to form the additive within the metal wiring material of the via contact of Pramanick et al. as taught by Halliyal et al. to reduce electromigration of copper or the movement of copper atoms along the channels or vias under the influence of electrical current (column 7, lines 6 – 10). Furthermore, the combined structure of Pramanick et al. and Halliyal et al. disclose the following limitation “the additive which is not contained in the metal wiring materials of the at least two wiring layers.”

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4. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pramanick et al. and Halliyal et al. as applied to claim 1 above, and further in view of Jan (U. S. Pat. No. 6,861,758).

While Pramanick et al. and Halliyal et al. disclose the use of the metal wiring material (101 and 204) being Al (column 4, lines 13 – 15), Pramanick et al. and Halliyal et al. do not disclose the additive being Cu or Si. Jan teaches in e.g., Fig. 9 an additive (the dopant material; column 2, lines 45 – 16) being Cu or Si (column 2, lines 49 – 51). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to further apply the Cu or Si of Jan as the specific material to form the additive within the metal wiring material of the via contact of Pramanick et al. and Halliyal et al. as taught by Jan to inhibit electromigration (column 3, lines 1 – 12).

#### ***Allowable Subject Matter***

5. Claim 4 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

(A) Claim 4 contains allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a metal wiring material being Ag and the additive being Cu.

#### ***Response to Arguments***

6. Applicant's arguments filed on May 4, 2009 have been fully considered but they are not persuasive.

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On page 7, applicant argues “Halliyal as disclosing ‘an additive within the metal wiring material of the via contact.’ However, Halliyal does not [to] teach or suggest that such additive is not contained in two metal wiring layers.” This argument is not persuasive because one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Furthermore, Pramanick et al. discloses in e.g., Fig. 4 at least two non-additive added wiring layers (101 and 204; column 4, lines 33 and 34) on the top and bottom surface of a via contact (202) and Halliyal et al. teaches in e.g., Fig. 1H the via contact (116; column 6, line 61) containing an additive (the dopant material; column 7, lines 1 – 6). Thus, a combined structure of Pramanick et al. and Halliyal discloses at least two non-additive added wiring layers on the top and bottom surfaces of an additive added via contact because the only teaching from the disclosure of Halliyal is the additive added via contact material into the via contact of Pramanick et al. Furthermore, the upper surface of the via contact (202) of Pramanick et al. has barrier layer (125; column 4, line 21) between the upper wiring layer (204) and the via contact (202) to prevent movement of materials between the upper wiring layer (204) and the via contact (202). Also, the bottom surface of the via contact (202) of Pramanick et al. has barrier layer (123; column 3, line 54) between the bottom wiring layer (101) and the via contact (202) to prevent movement of materials between the bottom wiring layer (204) and the via contact (202). Thus, the additive added via contact material of the combined structure of Pramanick et al. and Halliyal do not move into the upper wiring layer (204) and the bottom wiring layer (101). Therefore, the combined structure of Pramanick et al. and Halliyal discloses the following limitation “wherein the metal wiring material of the via contact contains

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an additive which is not contained in the metal wiring materials of the at least two wiring layers.”

Finally, applicant argues “[A]pplicants state the proposed modification is improper because such a modification as proposed in the Office Action would frustrate the purpose of the inventions of Pramanick et al. and Halliyal.” This argument is not persuasive because the barrier layers in Pramanick et al. reduce electromigration of copper or the movement of copper along the vias and wiring layers, and the via contact of Halliyal. taught reducing electromigration of copper or the movement of copper atoms along the channels or vias under the influence of electrical current (column 7, lines 6 – 10 of Halliyal.) was useful for Pramanick et al.’s purpose. Thus, the proposed modification (to reduce electromigration of copper or the movement of copper atoms along the channels or vias under the influence of electrical current; column 7, lines 6 – 10 of Halliyal.) is proper because the modification as proposed in the Office Action would benefit or increase the purpose of the inventions of Pramanick et al. and Halliyal.

For the above reasons, the rejection is maintained.

### ***Conclusion***

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRIS C. CHU whose telephone number is (571)272-1724. The examiner can normally be reached on 11:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Tuesday, June 30, 2009